# APPENDIX A

# ODOUR MODELLING

**Acknowledgements**

Rum Jungle Meat Exports acknowledge The Odour Consultants for their contribution to the content of this appendix



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# CENTRAL AGRI GROUP

## Batchelor Abattoir

## Proposed Recommencement

## Odour Impact Assessment

## Batchelor, NT

## Final Report

## June 2019

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# 1 INTRODUCTION

In May 2019, The Odour Unit (**TOU**) was engaged by Central Agri Group (**CAG**) to carry out an odour impact assessment (**OIA**) of the proposed recommencement of Batchelor Abattoir with inclusion of a rendering operation (**Batchelor Abattoir**) located off Meneling Road, Batchelor, Northern Territory (**NT**). The nominal location and perimeter of the Batchelor Abattoir activities are shown in **Figure 1.1** along with the nearest Bureau of Meteorology (**BoM**) surface station at Batchelor Airport (**YBCR**) and terrain elevations.

The proposed rendering plant will process only freshly killed material from the adjacent abattoir. No imported by-product material will be processed.

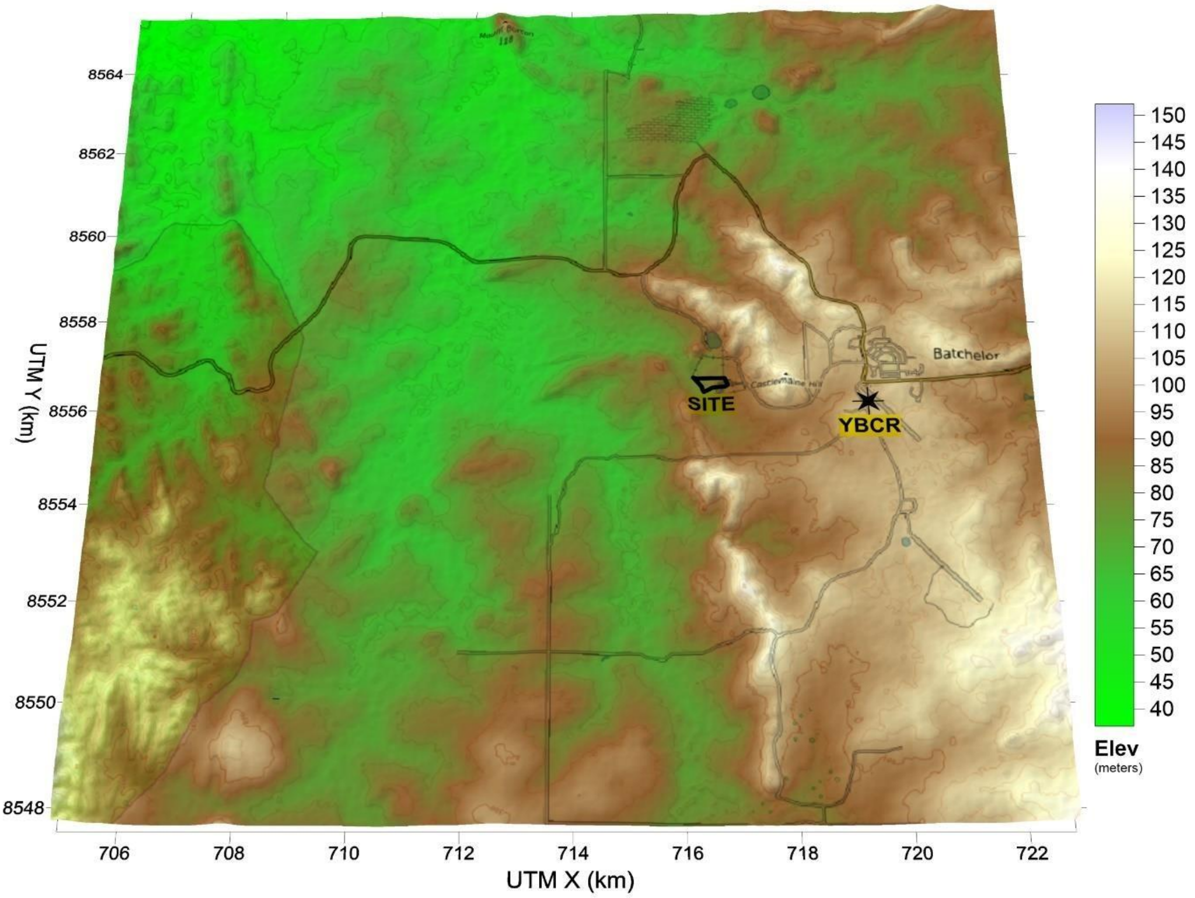



**Figure 1.1 - Batchelor Abattoir location (SITE) and surrounds**

## 1.1 RELEVANT BACKGROUND

Based upon TOU's consultations with Peter Vasel, NT Environment Protection Authority (**EPA**), at a minimum, require a desktop OIA of Batchelor Abattoir with the use of the refined dispersion modelling technique based upon the New South Wales (**NSW**) EPA Level 3 OIA procedure outlined in the documents:

- Technical Framework: Assessment and management of odour from stationary sources in NSW, November 2006 (**Odour Technical Framework**).
- Technical Notes: Assessment and management of odour from stationary sources in NSW, November 2006 (**Odour Technical Notes**).

The Odour Technical Notes states that the dispersion modelling requirements for a Level 3 OIA should adhere to the Level 2 impact assessment process in the NSW EPA document:

- Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, January 2017 (**Approved Modelling Methods**).

The OIA has considered four significant odour sources at Batchelor Abattoir:

- Three wastewater ponds – ○ Effluent Pond One (**EP1**) anaerobic, ○ Effluent Pond Two (**EP2**) facultative, and ○ Effluent Pond Three (**EP3**) facultative or aerobic; and
- One combined air discharge stack (**Stack**) from the dryer.

Locations of the sources are shown in **Figure 1.2** and **Figure 1.3**.

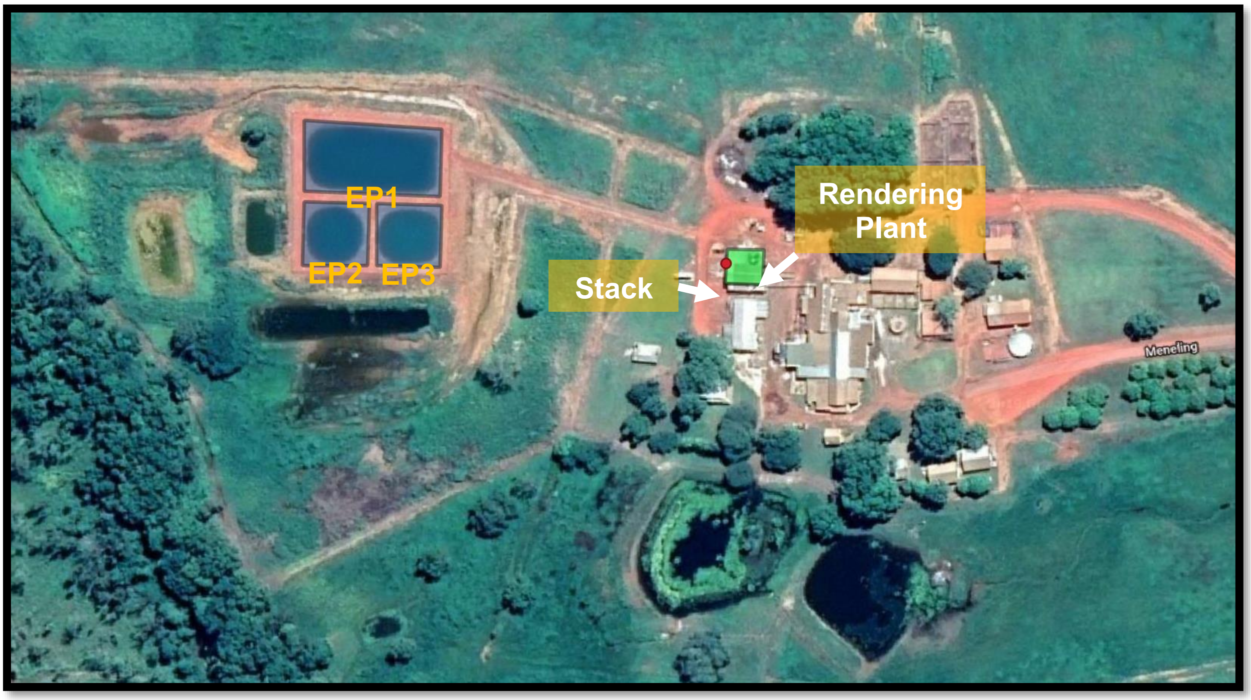


**Figure 1.2 – Location of wastewater ponds and discharge stack from the dryer**


**Figure 1.3 – Ground-level view of discharge stack from the dryer**

The proposed rendering plant will be based on the Low Temperature Rendering (LTR) process. This plant is already in place. All processing units upstream of the Dryer are fully enclosed such that odours can only vent through the Dryer exhaust stack...While some uncontained fugitive odour releases will occur, these will be low in intensity and localised to the rendering building precinct.

The wastewater pond system is characterised by three deep ponds (5 metres+) operating in series. The first pond will be fully anaerobic and able to maintain a 'crust' over the bulk of its surface area. Subsequent ponds will operate at lower organic loadings and be either facultative or aerobic. The odour emissions from these ponds will decrease as the wastewater is treated.

## 1.2 SCOPE OF WORKS

The odour dispersion modelling has been completed with odour emissions data for the wastewater ponds sourced from a site-representative facility, and with an upper-limit value for the stack source that can be used to inform odour mitigation technology selection, if found to be required. One scenario has been presented, this being the proposed operation of the Batchelor Abattoir rendering plant operations from 7 am to 4 pm daily.

# 2 ODOUR DISPERSION MODELLING METHODOLOGY

## 2.1 NSW ODOUR IMPACT CRITERIA AND DISPERSION MODELLING GUIDELINES

At the request of NT EPA, the OIA was undertaken in accordance with the NSW EPA Technical Framework, Technical Notes and Approved Modelling Methods. The documents specify that the odour modelling for Level 3 impact assessments be based on the use of:

- 99th percentile dispersion model predictions;
- 1-hour averaging times with built-in peak-to-mean ratios to adjust the averaging time to a 1-second nose-response-time (**P/M60**);
- The peak-to-mean ratios in the far-field for area sources are 2.3 for stability classes A to D and 1.9 for stability classes D to F;
- The peak-to-mean ratio in the far-field for wake-affected point sources is 2.3;
- The near field distance is defined as typically 10 times the largest source dimension, either height or width. For this OIA, it is 750 m from the area sources and 100 m from the stack source; and
- The appropriate impact assessment criteria (**IAC**) based on the population of the affected community near Batchelor Abattoir was determined to be **7.0 odour units (ou)** based upon the nearest receptors being single rural residences.

## 2.2 DISPERSION MODELLING

### 2.2.1 The odour dispersion model

The odour dispersion modelling assessment was carried out using the CALPUFF Modelling System. The main system programs used were:

- CALPUFF - Version 7.2.1 (Level 150618); and
- CALMET - Version 6.5.0 (Level 150223)

In addition to the Approved Modelling Methods, TOU followed the guidance and used settings for CALMET and CALPUFF outlined in:

- Barclay and Scire, 2011, Generic *Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'.* (**Generic CALPUFF Guidance**)

### 2.2.2 Geophysical and meteorological configuration

A CALMET hybrid three-dimensional meteorological data file for Batchelor Abattoir was produced that incorporated gridded numerical meteorological data supplemented with surface observation data, topography and land use over the domain area.

### 2.2.3 Terrain configuration

Terrain elevations were sourced from the *1 Second Shuttle Radar Topography Mission (**SRTM**) Derived Smoothed Digital Elevation Model (**DEM-S**)*. The SRTM data has been treated with several processes including but not limited to removal of stripes, void filling, tree offset removal and adaptive smoothing (Gallant, et al., 2011). The DEM-S was used as input into TERREL processor to produce an 18 km by 18 km grid at 0.15 km resolution. The processed terrain elevations for the model domain have been illustrated in Figure 1.1 above.

### 2.2.4 Land use configuration

Land use was sourced from the *United States Geological Survey* (**USGS**) *Global Land Cover Characteristics Data Base for the Australia-Pacific Region* (United States Geological Survey, 1997). The data was used as input into CTGPROC processor to produce an 18 km by 18 km grid at 0.15 km resolution.

### 2.2.5 Geophysical configuration

A geophysical data file was created using the MAKEGEO processor. Land use data from CTGPROC and terrain data from TERREL was used as input to produce an 18 km by 18 km geophysical grid at 0.15 km resolution.

### 2.2.6 Meteorological input data

One-hour average observed meteorological surface data for 2017 was sourced from YBCR station that is maintained by BoM. The surface data was formatted into a generic format and processed with SMERGE to produce a surface meteorological data file.

Numerical meteorological data was produced as a 3D data tile from The Air Pollution Model (**TAPM**) v4.0.5 processed with CALTAPM (v7.0.0) into a suitable format. TAPM was run using multiple nested grids – at least three nests and 35 vertical levels. The nested grid resolutions were close to a ratio of three as possible. The innermost nest was 30 km by 30 km at 1 km resolution.

### 2.2.7 Meteorological model configuration

CALMET was run using the hybrid option that uses geophysical data, surface station data and upper air data. The data was used to initialise the diagnostic functions of the CALMET module to produce a full 3D meteorology data for input into CALPUFF. **Table 2.1** shows the key variables selected.

<table>
<tr><th colspan="13">Table 2.1 – CALMET key variable fields</th></tr>
<tr><th colspan="13">Grid Configuration (WGS-84 UTM Zone 56S)</th></tr>
<tr><td colspan="6">120</td><td colspan="7">NX Cells</td></tr>
<tr><td colspan="6">120</td><td colspan="7">NY Cells</td></tr>
<tr><td colspan="6">0.15</td><td colspan="7">Cell Size (km)</td></tr>
<tr><td colspan="4">704.879</td><td colspan="2">8547.480</td><td colspan="7">SW Corner (km)</td></tr>
<tr><td colspan="6">11</td><td colspan="7">Vertical Layers</td></tr>
<tr><td>ZFACE (m)</td><td>0</td><td>20</td><td>40</td><td>80</td><td>160</td><td>320</td><td>640</td><td>1000</td><td>1500</td><td>2000</td><td>2500</td><td>3000</td></tr>
<tr><td>LAYER</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td></td></tr>
<tr><td>MID-PT (m)</td><td>10</td><td>30</td><td>60</td><td>120</td><td>240</td><td>480</td><td>820</td><td>1250</td><td>1750</td><td>2250</td><td>2750</td><td></td></tr>
</table>

| Critical Wind Field Settings | | | |
|---|---|---|---|
| **Value** | **Found** | **Typical** | **Values** |
| TERRAD | 5 | None | Terrain scale (km) for terrain effects |
| IEXTRP | -4 | 4, -4 | Similarity extrap. of wind (-4 ignore upper stn sfc) |
| ICALM | 0 | 0 | Do Not extrapolate calm winds |
| RMAX1 | 5 | None | MAX radius of influence over land in layer 1 (km) |
| RMAX2 | 6 | None | MAX radius of influence over land aloft (km) |
| R1 | 0.15 | None | Distance (km) where OBS wt = IGF wt in layer 1 |
| R2 | 0.15 | None | Distance (km) where OBS wt = IGF wt aloft |

### 2.2.8 Meteorological data output

Observed 2017 surface wind data from YBCR station is available in **Figure 2.1.** The surface wind data observed for the recent five-year period 2014 to 2018 is shown in **Figure 2.2**. The modelled meteorological surface wind data extracted from CALMET nearby the Proposed Development location is illustrated in **Figure 2.3**.

The monthly average temperatures, diurnal average temperature, diurnal mixing heights and stability class frequencies are shown in **Figure 2.4**, **Figure 2.5, Figure 2.6** and **Figure 2.7** respectively.

| WDDIR | 0.5- 2.0 | 2.0- 4.0 | 4.0- 6.0 | 6.0- 8.0 | 8.0-10.0 | > 10.0 | SUM |
|---|---|---|---|---|---|---|---|
| N : | 2.7% | 1.3% | 0.1% | 0.0% | 0.0% | 0.0% | 4.0% |
| NNE: | 2.4% | 1.0% | 0.0% | 0.0% | 0.0% | 0.0% | 3.4% |
| NE : | 2.6% | 1.2% | 0.1% | 0.0% | 0.0% | 0.0% | 4.0% |
| ENE: | 2.9% | 2.4% | 0.4% | 0.0% | 0.0% | 0.0% | 5.7% |
| E : | 3.6% | 4.0% | 1.9% | 0.4% | 0.0% | 0.0% | 9.9% |
| ESE: | 3.3% | 4.4% | 3.6% | 1.1% | 0.0% | 0.0% | 12.4% |
| SE : | 3.5% | 3.9% | 0.8% | 0.2% | 0.0% | 0.0% | 8.5% |
| SSE: | 1.8% | 0.5% | 0.1% | 0.0% | 0.0% | 0.0% | 2.4% |
| S : | 1.5% | 0.2% | 0.0% | 0.0% | 0.0% | 0.0% | 1.7% |
| SSW: | 1.1% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 1.2% |
| SW : | 1.3% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 1.5% |
| WSW: | 1.9% | 0.5% | 0.1% | 0.0% | 0.0% | 0.0% | 2.6% |
| W : | 4.6% | 1.9% | 0.3% | 0.0% | 0.0% | 0.0% | 6.8% |
| WNW: | 4.5% | 3.2% | 0.5% | 0.0% | 0.0% | 0.0% | 8.2% |
| NW : | 4.0% | 1.8% | 0.3% | 0.0% | 0.0% | 0.0% | 6.2% |
| NNW: | 2.2% | 1.3% | 0.1% | 0.0% | 0.0% | 0.0% | 3.7% |
| SUM: | 44.1% | 28.0 % | 8.5 % | 1.7 % | 0.0 % | 0.0 % | 82.3 % |
| Calm Winds: | 17.7% | | | | | | |

| WDDIR | 0.5- 2.0 | 2.0- 4.0 | 4.0- 6.0 | 6.0- 8.0 | 8.0-10.0 | > 10.0 | SUM |
|---|---|---|---|---|---|---|---|
| N : | 3.0% | 1.1% | 0.1% | 0.0% | 0.0% | 0.0% | 4.1% |
| NNE: | 2.5% | 0.8% | 0.0% | 0.0% | 0.0% | 0.0% | 3.4% |
| NE : | 2.3% | 1.3% | 0.1% | 0.0% | 0.0% | 0.0% | 3.7% |
| ENE: | 2.6% | 2.4% | 0.4% | 0.0% | 0.0% | 0.0% | 5.4% |
| E : | 3.3% | 4.0% | 1.7% | 0.3% | 0.0% | 0.0% | 9.3% |
| ESE: | 2.8% | 4.0% | 2.8% | 0.8% | 0.0% | 0.0% | 10.4% |
| SE : | 2.8% | 3.9% | 1.2% | 0.3% | 0.0% | 0.0% | 8.3% |
| SSE: | 1.9% | 0.6% | 0.1% | 0.0% | 0.0% | 0.0% | 2.6% |
| S : | 1.4% | 0.3% | 0.0% | 0.0% | 0.0% | 0.0% | 1.7% |
| SSW: | 1.0% | 0.2% | 0.0% | 0.0% | 0.0% | 0.0% | 1.2% |
| SW : | 1.5% | 0.3% | 0.0% | 0.0% | 0.0% | 0.0% | 1.8% |
| WSW: | 2.6% | 0.7% | 0.1% | 0.0% | 0.0% | 0.0% | 3.4% |
| W : | 4.7% | 2.3% | 0.3% | 0.0% | 0.0% | 0.0% | 7.4% |
| WNW: | 4.7% | 3.8% | 0.6% | 0.1% | 0.0% | 0.0% | 9.3% |
| NW : | 4.0% | 2.1% | 0.4% | 0.0% | 0.0% | 0.0% | 6.6% |
| NNW: | 2.5% | 1.2% | 0.2% | 0.0% | 0.0% | 0.0% | 3.8% |
| SUM: | 43.8% | 29.0 % | 8.0 % | 1.5 % | 0.0 % | 0.0 % | 82.3 % |
| Calm Winds: | 17.7% | | | | | | |

| WDDIR | 0.5- 2.0 | 2.0- 4.0 | 4.0- 6.0 | 6.0- 8.0 | 8.0-10.0 | > 10.0 | SUM |
|---|---|---|---|---|---|---|---|
| N : | 2.6% | 0.9% | 0.0% | 0.0% | 0.0% | 0.0% | 3.6% |
| NNE: | 2.2% | 1.2% | 0.0% | 0.0% | 0.0% | 0.0% | 3.4% |
| NE : | 3.1% | 1.3% | 0.2% | 0.0% | 0.0% | 0.0% | 4.6% |
| ENE: | 3.7% | 2.4% | 0.4% | 0.0% | 0.0% | 0.0% | 6.4% |
| E : | 4.4% | 6.2% | 1.7% | 0.2% | 0.0% | 0.0% | 12.5% |
| ESE: | 3.6% | 10.4% | 5.4% | 1.4% | 0.0% | 0.0% | 20.9% |
| SE : | 2.3% | 9.8% | 5.3% | 1.0% | 0.0% | 0.0% | 18.4% |
| SSE: | 0.9% | 0.8% | 0.4% | 0.0% | 0.0% | 0.0% | 2.1% |
| S : | 0.7% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% | 0.9% |
| SSW: | 0.3% | 0.3% | 0.1% | 0.0% | 0.0% | 0.0% | 0.6% |
| SW : | 0.5% | 0.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.9% |
| WSW: | 0.7% | 0.6% | 0.7% | 0.1% | 0.0% | 0.0% | 2.1% |
| W : | 1.6% | 2.2% | 1.2% | 0.1% | 0.0% | 0.0% | 5.2% |
| WNW: | 2.2% | 2.8% | 1.2% | 0.2% | 0.0% | 0.0% | 6.4% |
| NW : | 2.8% | 2.9% | 0.5% | 0.1% | 0.0% | 0.0% | 6.3% |
| NNW: | 3.1% | 1.2% | 0.0% | 0.0% | 0.0% | 0.0% | 4.3% |
| SUM: | 34.7% | 43.6 % | 17.2 % | 3.2 % | 0.0 % | 0.0 % | 98.6 % |
| Calm Winds: | 1.4% | | | | | | |

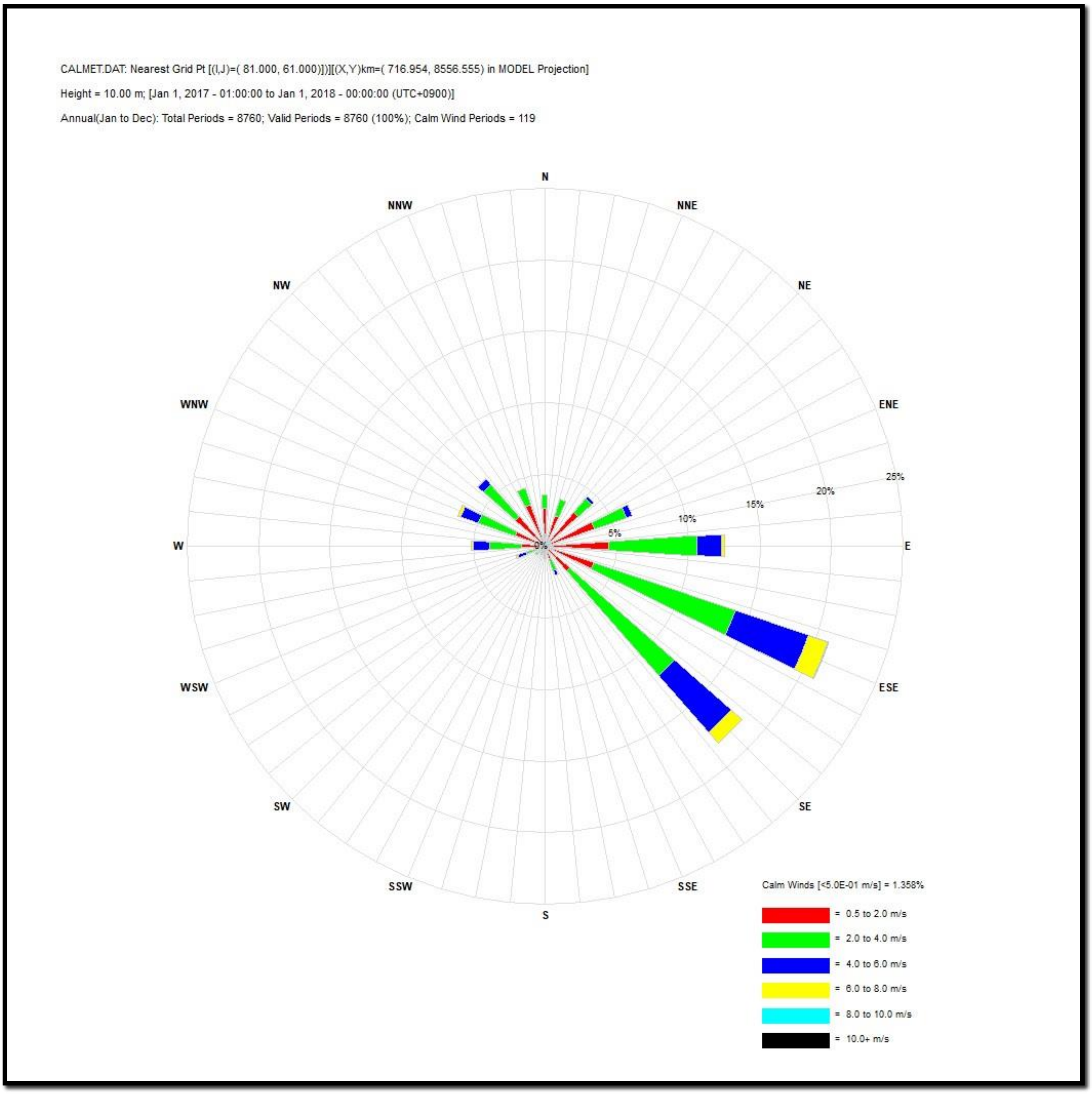



**Figure 2.1 – Annual wind rose for YBCR station 2017 Figure 2.2 – Annual wind rose for YBCR station 2014 -2018 Figure 2.3 – Annual wind rose for Batchelor Abattoir 2017 (CALMET)**

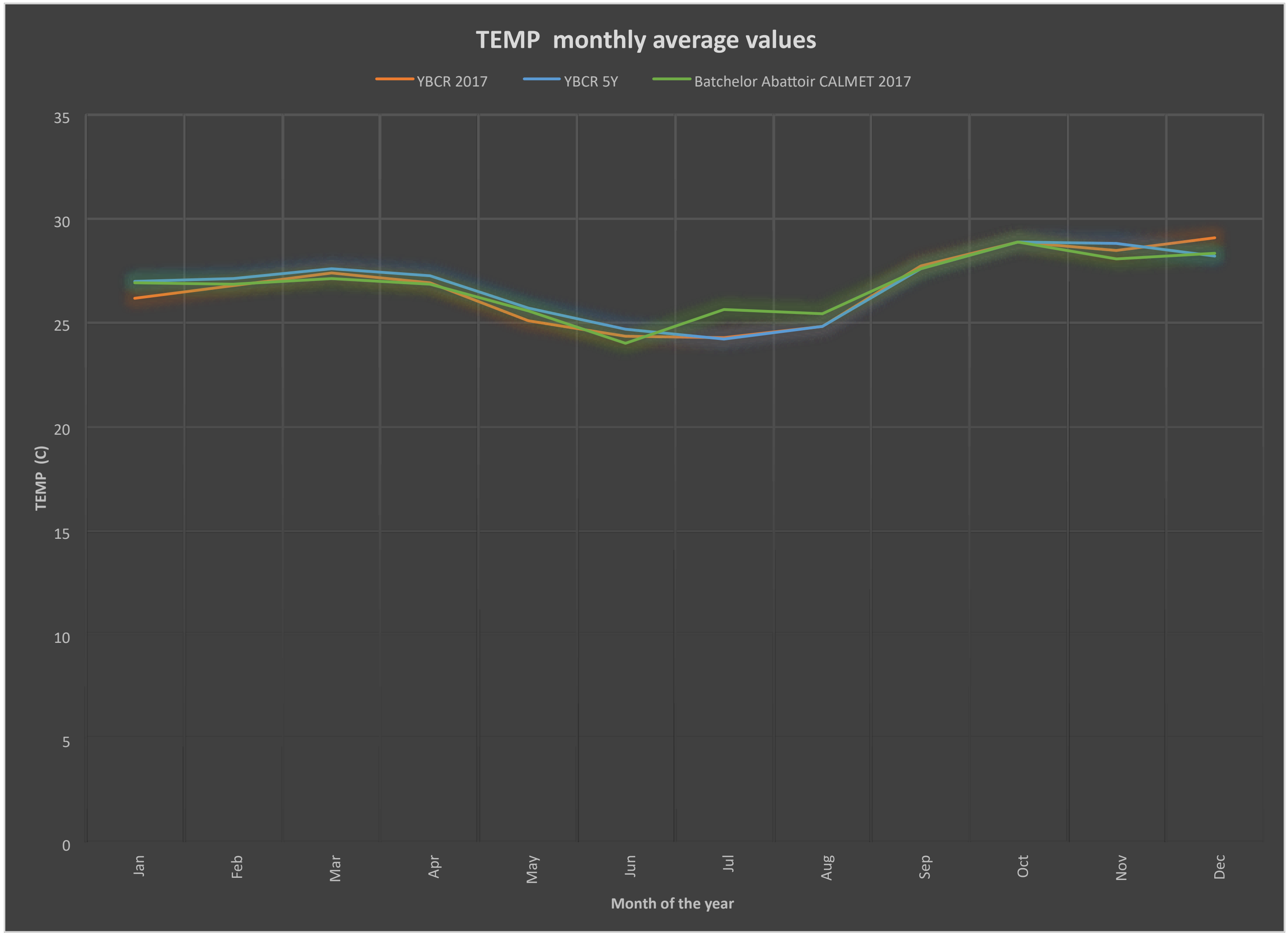



**Figure 2.4 – Monthly average temperatures for YBCR 2017, YBCR 5-years and Batchelor Abattoir (CALMET).**

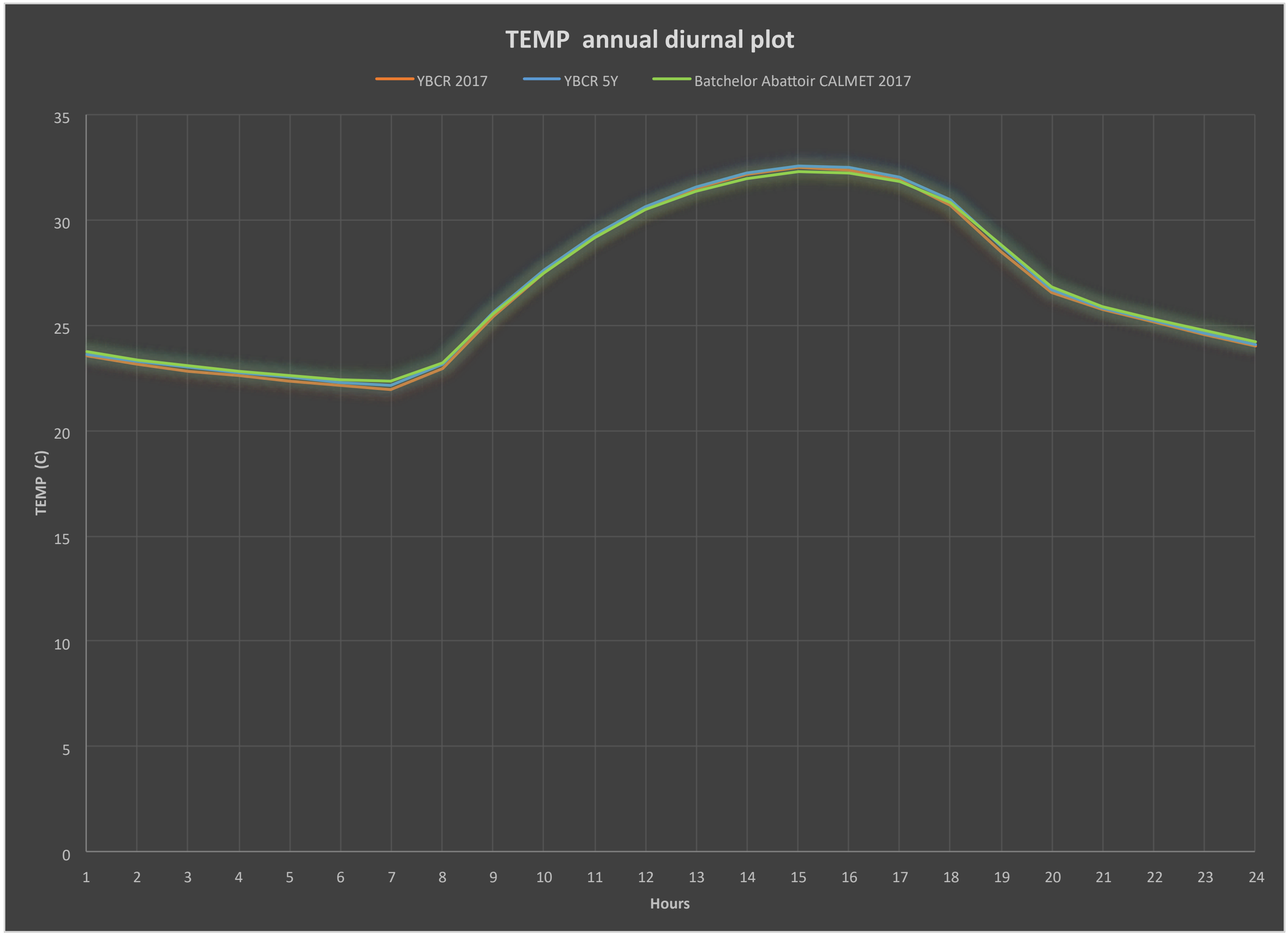
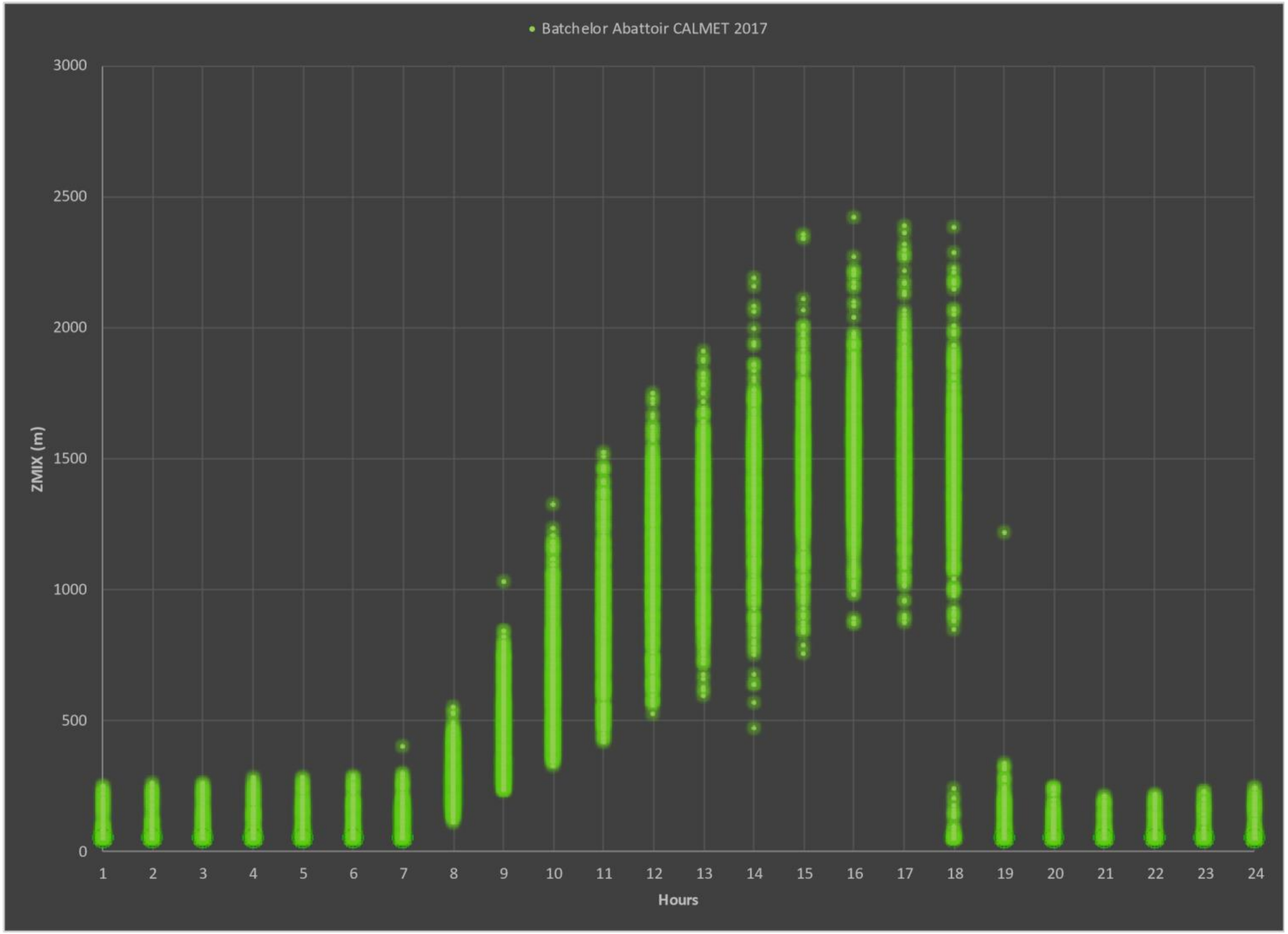

TEMP annual diurnal plot
YBCR 2017
YBCR 5Y
Batchelor Abattoir CALMET 2017
TEMP (C)
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hours

**Figure 2.5 – Annual diurnal temperature for YBCR 2017, YBCR 5-years and Batchelor Abattoir (CALMET)**



Batchelor Abattoir CALMET 2017
3000
2500
2000
1500
1000
500
0
ZMIX (m)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hours

**Figure 2.6 – Annual X-Y scatter plot diurnal mixing height for Batchelor Abattoir (CALMET)**

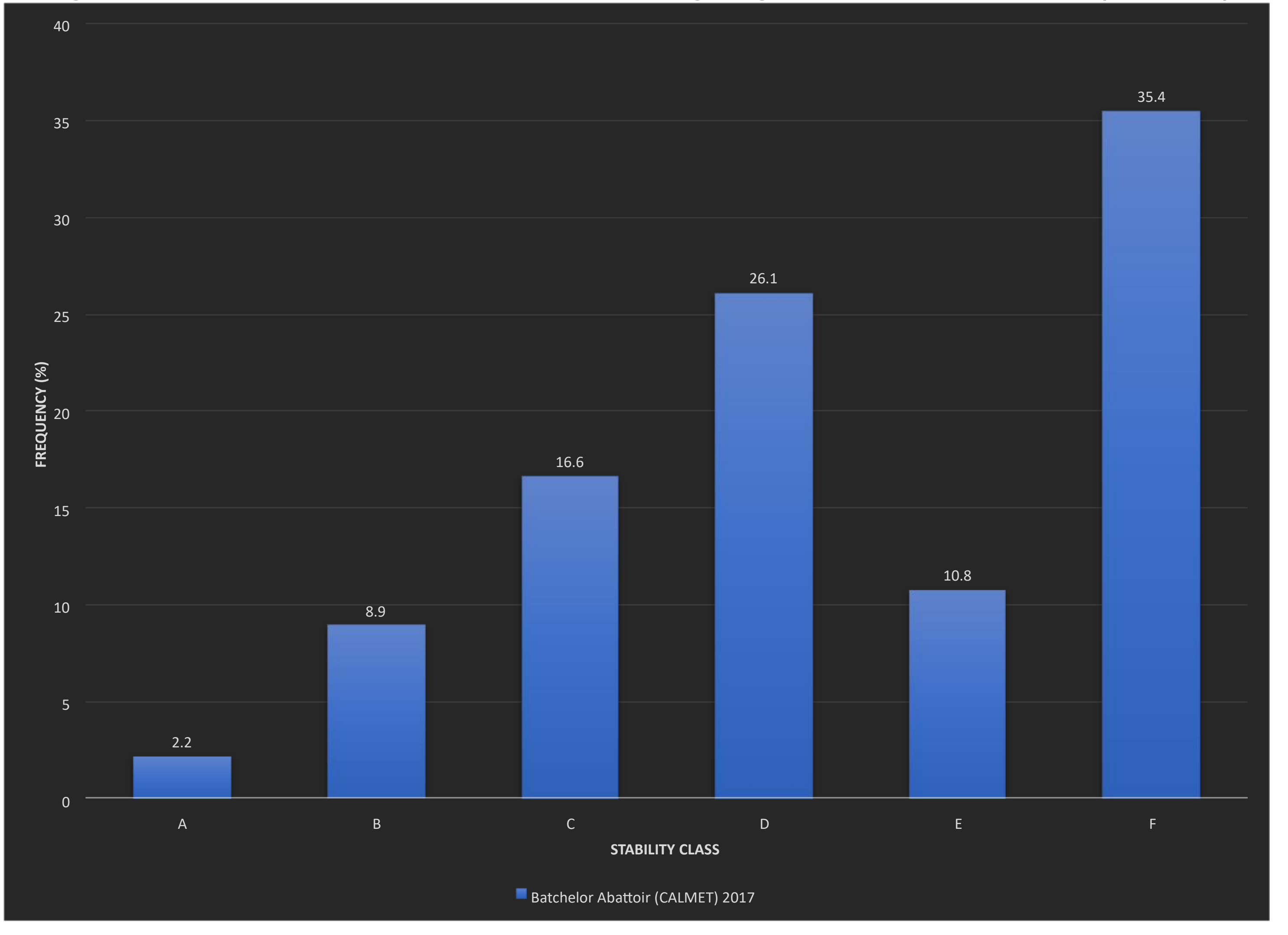


**Figure 2.7 – Annual stability class frequency for Batchelor Abattoir (CALMET)**

### 2.2.9 CALPUFF computational domain and receptor configuration

The computational domain was set the cover the entire the meteorological domain. A receptor grid was created with a 5.75 km by 4.55 km by 0.05 km spacing centred near the Batchelor Abattoir site. Two discrete receptors were created over nearby dwellings visible from satellite imagery. Discrete Receptor A is located approximately 2.2 km to the west and Discrete Receptor B is located approximately 1.8 km to the northnorthwest of the Batchelor Abattoir site activity boundary.

### 2.2.10 CALPUFF model options

CALPUFF default model options were set except for the following as recommended in *Table A*-4 contained and explained within *Barclay & Scire, 2011*:

- Dispersion coefficients (MDISP) = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (2);
- Probability Density Function used for dispersion under convective conditions (MPDF) = Yes (1); and
- Minimum turbulence velocities sigma v for each stability class over land and water (SVMIN) = 0.2 m/s for A, B, C, D, E, F (0.200, 0.200, …, 0.200).

Further model configurations and BPIP details are available in a sample CALPUFF list file in **Appendix A.**

### 2.2.11 Odour dispersion modelling scenarios

- **Scenario 1** – Predicted 7 ou (99%, P/M60) impact from the proposed recommencement of Batchelor Abattoir operations.

### 2.2.12 CALPUFF source and odour emission rate configuration

The specific odour emission rates (**SOER**s) for the three wastewater ponds were estimated from previous odour emissions testing carried out by TOU at a siterepresentative abattoir and rendering facility located in the Hunter region of NSW. SOER results from the odour testing of the wastewater ponds are available in **Table 2.2**.

**Table 2.2 – Results from a site-representative abattoir and rendering facility**

| Sample location | TOU sample number | SOER ($ou.m^3/m^2.s$) |
|---|---|---|
| Maturation Pond | SC14365 | 0.045 |
| Maturation Pond | SC14366 | 0.090 |
| Aerobic Pond | SC14367 | 0.048 |

| | | |
|---|---|---|
| Aerobic Pond | SC14368 | 0.037 |
| Aerobic Pond | SC14369 | 0.046 |
| Aerobic Pond | SC14370 | 0.035 |
| Anaerobic Pond – Crusted surface | SC14377 | 11.1 |
| Anaerobic Pond – Non-crusted surface | SC14378 | 20.3 |

For the area sources at the Batchelor Abattoir site, the largest wastewater pond EP1 was assumed to operate as a crusted anaerobic pond, and consequently an SOER of 11.1 ou.m$^3$/m$^2$.s was selected for the modelling.

Because the smaller pair of wastewater ponds, EP2 and EP3, were assumed to operate in a facultative state (near-aerobic surface layer, anaerobic at depth), a highly conservative SOER of 2.78 ou.m$^3$/m$^2$.s was selected for the modelling. This represents a 75% reduction from the anaerobic pond SOER. The need for this approach resulted from a lack of quantitative SOER data for facultative ponds treating beef abattoir wastewaters. The selected SOER is considered to be highly conservative, given that it is more than 60 times higher than the geomean measured from the fully aerobic ponds in **Table 2.2.**

For the point source at the Batchelor Abattoir site, the existing LTR Dryer Stack was modelled to be 10 m high with a diameter of 500 mm, and having a maximum discharge velocity of 10 m/s and a temperature of 90 °C. Based upon this flow rate of 7,060 m$^3$/h, the odour emission rate (**OER**) is 98,175 ou.m$^3$/s, emitting only between the plant's proposed operating hours of 7 am to 4 pm.

It should be noted that TOU's extensive odour emissions database for meat processing industry air emissions did not contain a representative odour concentration value for a Dryer emission from a low-temperature rendering plant, of the type to be operated at Batchelor. Given that the plant will only be processing freshly killed material from the adjacent abattoir, together with the general consensus that LTR plants generate odours at lower concentrations than corresponding high temperature plants, the likelihood of the stack emitting odour at greater than 50,000 ou is considered remote.

Full odour source configuration and OER details are available in **Appendix B**.



# 3 ODOUR DISPERSION MODELLING RESULTS

The odour dispersion modelling results are presented in **Figure 3.1** and **Table 3.1**. against the NSW EPA odour IAC of 7.0 ou, 99th percentile with one second noseresponse-time averaging (P/M60).

The results show that the predicted ground level concentrations from the Batchelor Abattoir scenario are well below the odour IAC at the nearest sensitive receptors. Note that the contour for the wastewater ponds is mostly covered by the contour for all sources.

**Table 3.1 – Predicted odour impact at discrete receptors**

| Discrete Receptor | UTM X (km) | UTM Y (km) | Elevation (m) | Ground level odour concentration (99%, P/M60) |
|---|---|---|---|---|
| A | 714.215 | 8556.250 | 70.9 | 3.7 |
| B | 715.723 | 8558.313 | 100.8 | 1.1 |

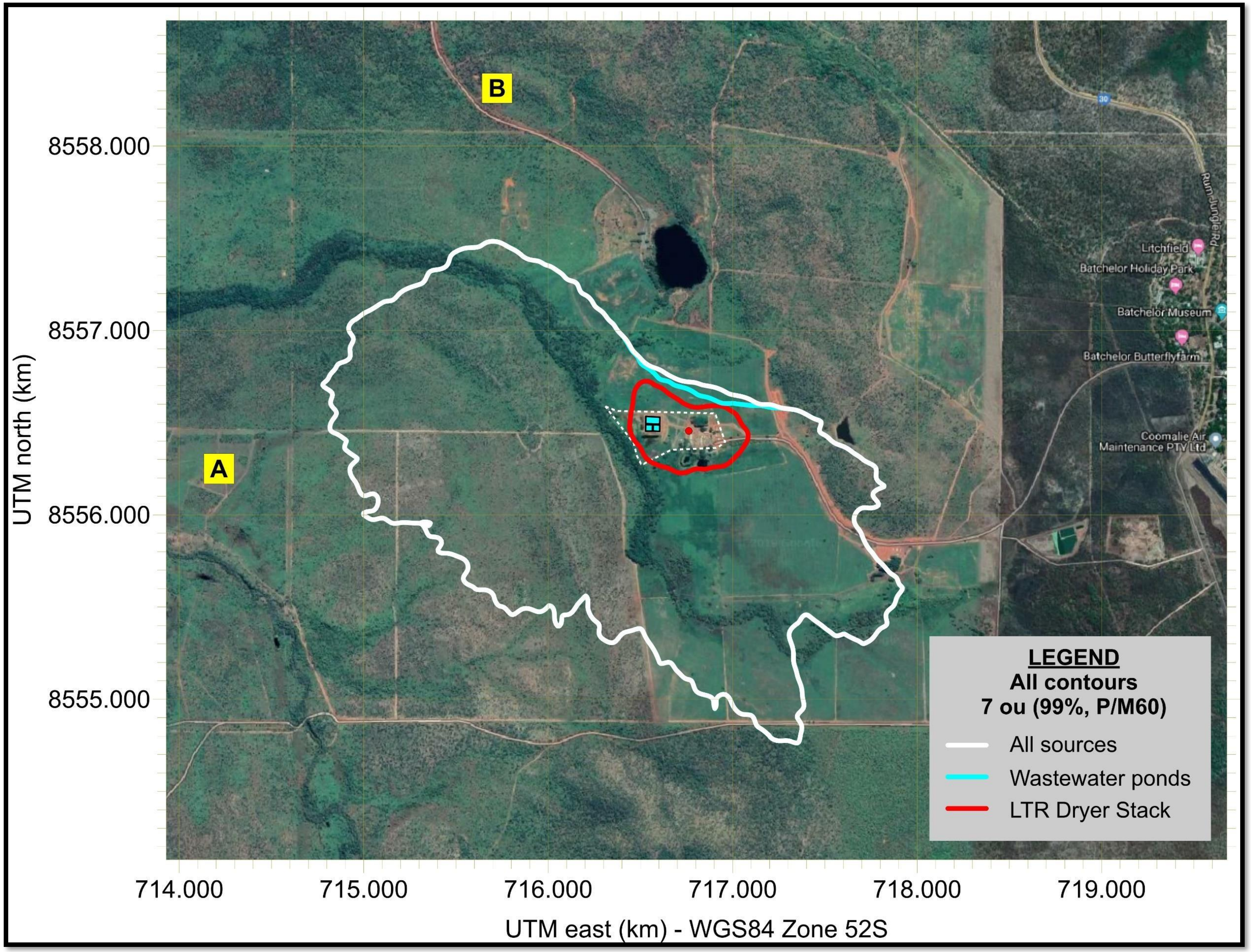



**Figure 3.1 – Scenario 1: Predicted 7 ou (99%, P/M60) impact from the proposed Batchelor Abattoir and rendering plant operations**

# 4 FINDINGS AND CONCLUSIONS

TOU was engaged by CAG to carry out an OIA of the proposed recommencement of Batchelor Abattoir with inclusion of a low temperature rendering operation. A desktop assessment was completed as required by NT EPA with the use of a refined dispersion modelling technique based upon methodology outlined in the NSW EPA Odour Technical Framework, Odour Technical Notes and Approved Modelling Methods. The odour dispersion modelling was carried out using the CALPUFF Modelling System following guidance and settings recommended in the Generic CALPUFF guidance document for NSW EPA.

A conservative set SOERs for the wastewater ponds were derived from previous odour emissions testing carried out by TOU from a site-representative facility in the Hunter region of NSW. For the modelling, the largest wastewater pond (EP1) for Batchelor Abattoir was assumed to be equivalent to the crusted anaerobic pond measured in the Hunter region. The smaller pair of wastewater ponds (EP2 and EP3) were assumed to be operated in a facultative state (aerobic surface layer) with an SOER that was 75% less than the crusted anaerobic pond SOER.

An upper-limit OER value was determined for the existing stack source. The Stack was assumed to be 10 m high with a diameter of 500 mm, with a maximum discharge concentration of 50,000 ou at 10 m/s and 90 °C. This odour emission concentration is considered most unlikely to be exceeded.

One scenario was presented being the proposed operation of the Batchelor Abattoir rendering plant from 7 am to 4 pm daily. The results have shown that the predicted ground level concentrations from the Batchelor Abattoir scenario are well below the odour IAC at the nearest sensitive receptors.

The odour dispersion modelling has found that the proposed abattoir and rendering plant can be operated with an anaerobic pond and facultative wastewater system, and a Stack emitting an OER up to 98,175 ou.m$^3$/s, without causing any adverse odour impacts.

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# REPORT SIGNATURE PAGE

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Signed by:

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# CENTRAL AGRI GROUP

## Batchelor Abattoir
## Proposed Recommencement
## Odour Impact Assessment

## Batchelor, NT

## Appendices

## June 2019

**Appendix A –**

Sample CALPUFF list file

```
                                CALPUFF        Version: 7.2.1          Level: 150618
*************************************************************************************************************************************




 Clock time: 17:11:08
```

```
       Date: 05-27-2019



 Internal Coordinate Transformations by  ---  COORDLIB   Version: 1.99   Level: 070921



 Control File Type: CALPUFF.INP     7.0             Groups 0f,0g added; new emission scaling



  Run Title:
     Central Agri Group Batchelor Odour Impact Assessment
     EP1 - Unit Emission Rate
S. Hayes 24/05/2019
    ****  CONFIRMATION OF CONTROL DATA  ****



 --------------  INPUT GROUP 1  ---------------
   metrun   =   0   ibyr
=  2017   ibmo     =  1
ibdy    =  1  ibhr    =
0  ibsec   =  0  ibdathr
=  201700100  ieyr    =
2018  iemo    =  1  iedy
=  1  iehr    =  0  iesec
=     0     iedathr   =
201800100   nsecdt   =
3600   irlg     =  8760
iavg    =  1  xbtz    =
-9.00000000  abtz     =
UTC+0900  nspec   =  1
nse     =  1  itest   =
2  metfm   =  1  mprffm
=   1   mrestart=   0
nrespd  =  0  avet    =
60.0000000   pgtime   =
60.0000000  ioutu   =  2


 --------------  INPUT GROUP 2  ---------------
   mgauss =  1  mctadj =
3  mctsg  =  0  mslug  =
0  mtrans =  1  mchem  =
0  maqchem =  0  mlwc   =
0  mwet   =  0  mdry   =
0  mtilt  =  0  mdisp  =
2  mdisp2 =  3  mturbvw =
3           mtauly     =
0.00000000E+00   mtauadv=
0  mcturb =  1  mrough =
0  mtip   =  1  mbdw   =
2  mshear =  0  mrise  =
1  mrise_fl=  2  mtip_fl=
0  msplit =  0  mpartl =
1  mpartlba=  1  mtinv  =
0  mpdf   =  1  msgtibl=
0  mbcon  =  0  msource=
0  mfog   =  0  mreg   =
0


 --------------  INPUT GROUP 3  ---------------


 SPECIES: ODOR          j: 1  isplst(-,j) =   1  1  0  GROUP: ODOR


 --------------  INPUT GROUP 4  ---------------
   pmap    = UTM       datum   = WGS-84    daten   = 02-21-2003    utmhem  = S     iutmzn  =  52  nx      =  120  ny      =  120  nz      =  11
zface  =  0.00000000E+00 20.0000000 40.0000000 80.0000000 160.000000 320.000000 640.000000 1000.00000 1500.00000 2000.00000 2500.00000 3000.00000
dgridkm =  0.150000006  xorigkm =  704.879028  yorigkm =  8547.48047  iutmzn  =  52  ibcomp  =  1  jbcomp  =  1  iecomp  =  120  jecomp  =  120



lsamp    =   T
ibsamp   =  61
jbsamp   =  45
iesamp   =  99
jesamp   =  75
meshdn  =  3


--------------  INPUT GROUP 5  ---------------
  icon    =  1
idry     =  0
iwet     =  0
it2d     =  0
irho     =  0
ivis     =  0
lcomprs =   T
icprt    =  0
idprt    =  0
iwprt    =  0
icfrq    =  1
idfrq    =  1
iwfrq   =  1
 (note:  i_frq values converted to timesteps)
iprtu   =  5  imesg   =  2  imflx   =  0
imbal   =  0  inrise  =  0  iqaplot =  1
ipftrak =  0  ldebug  =  F  ipfdeb  =  1
npfdeb  =  1  nn1     =  1  nn2     =  10
```

```
 GROUP: ODOR          j:   1  ioutop(-,j) =  0 1 0 0 0 0 0


 --------------  INPUT GROUP 6  ---------------


         ------  Subgroup (6a)  ------
   nhill  =  0  nctrec =
0  mhill  =  2  xhill2m=
1.00000000  zhill2m=
1.00000000  xctdmkm=
0.00000000E+00  yctdmkm=
0.00000000E+00


         ------  Subgroup (6b)  ------



         ------  Subgroup (6c)  ------



 --------------  INPUT GROUP 7  ---------------


 SPECIES: ODOR          j:   1  dryg(-,j) =    -999.00   -999.00   -999.00   -999.00   -999.00


 --------------  INPUT GROUP 8  ---------------


 SPECIES: ODOR          j:   1  dryp(-,j) =    -999.00   -999.00


 --------------  INPUT GROUP 9  ---------------
   rcutr    =   30.0000000
rgr        =   10.0000000
reactr    =    8.00000000
pconst   =   2.30000001E-08
bmin     =  1.00000001E-07
bmax     =  2.49999994E-06
qswmax    =    600.000000
dconst1   =     2.00000000
dconst2   =    0.666666687
dconst3  =   4.79999988E-04
dconst4   =    0.666666687
nint    =  9  iveg    =  1


 --------------  INPUT GROUP 10  ---------------


 SPECIES: ODOR          j:   1  wa(-,j) =  0.000E+00   0.000E+00


 --------------  INPUT GROUP 11  ---------------
   moz     =  1  bcko3m   =  80.0000000 80.0000000 80.0000000
80.0000000              =  80.0000000 80.0000000 80.0000000
80.0000000              =  80.0000000 80.0000000 80.0000000
80.0000000  mnh3    =  0  mavgnh3  =  1  bcknh3m  =  10.0000000
10.0000000 10.0000000 10.0000000              =  10.0000000
10.0000000 10.0000000 10.0000000              =  10.0000000
10.0000000 10.0000000 10.0000000  rnite1    =  0.200000003
rnite2   =  2.00000000  rnite3   =  2.00000000  mh2o2    =  1
bckh2o2m  =    1.00000000  1.00000000  1.00000000  1.00000000
=  1.00000000 1.00000000 1.00000000 1.00000000            =
1.00000000  1.00000000  1.00000000  1.00000000   rh_isrp   =
50.0000000  so4_isrp =  4.00000005E-07  bckpmf  =  1.00000000
1.00000000 1.00000000 1.00000000              =  1.00000000
1.00000000 1.00000000 1.00000000              =  1.00000000
1.00000000 1.00000000 1.00000000   ofrac     =  0.150000006
0.150000006 0.200000003 0.200000003          =  0.200000003
0.200000003 0.200000003 0.200000003          =  0.200000003
0.200000003 0.200000003 0.150000006  vcnx     =  50.0000000
50.0000000 50.0000000 50.0000000              =  50.0000000
50.0000000 50.0000000 50.0000000
          =  50.0000000 50.0000000 50.0000000 50.0000000


--------------  INPUT GROUP 12  ---------------
  sytdep   =  550.000000 mhftsz   =  0 jsup
=  5 conk1    =  9.99999978E-03 conk2    =
0.100000001 iurb1    =  10 iurb2    =  19
anemht     =   10.0000000  isigmav   =   1
imixctdm =  0  ilanduin =  20  z0in     =
0.250000000  xlaiin   =  3.00000000  elevin
=  0.00000000E+00  xlatin   =  -999.000000
xlonin    =   -999.000000      xmxlen    =
1.00000000   mxnew      =   99  xsamlen   =
1.00000000  mxsam    =  99  ncount   =  2
sl2pf       =   10.0000000   wscalm     =
0.499994993   cdiv       =   0.00000000E+00
0.00000000E+00
   tkcat    =  265.000000   top for class
1  tkcat    =  270.000000   top for class
2  tkcat    =  275.000000   top for class
3  tkcat    =  280.000000   top for class
4  tkcat    =  285.000000   top for class
5  tkcat    =  290.000000   top for class
6  tkcat    =  295.000000   top for class
7  tkcat    =  300.000000   top for class
8  tkcat    =  305.000000   top for class
9  tkcat    =  310.000000   top for class
10  tkcat    =  315.000000   top for class
11
   wscat    =  1.53999996   top for class
1  wscat    =  3.08999991   top for class
2  wscat    =  5.13999987   top for class
```

```
3  wscat    =  8.22999954   top for class
4  wscat    =  10.8000002   top for class
5
   Over LAND  svmin     =  0.200000003  for
stability 1  svmin     =  0.200000003  for
stability 2  svmin     =  0.200000003  for
stability 3  svmin     =  0.200000003  for
stability 4  svmin     =  0.200000003  for
stability 5  svmin     =  0.200000003  for
stability 6  swmin     =  0.200000003  for
stability 1  swmin     =  0.119999997  for
stability 2  swmin    =  7.99999982E-02  for
stability 3  swmin    =  5.99999987E-02  for
stability 4  swmin    =  2.99999993E-02  for
stability 5  swmin    =  1.60000008E-02  for
stability 6
   Over WATER  svmin     =  0.200000003  for
stability 1  svmin     =  0.200000003  for
stability 2  svmin     =  0.200000003  for
stability 3  svmin     =  0.200000003  for
stability 4  svmin     =  0.200000003  for
stability 5  svmin     =  0.200000003  for
stability 6  swmin     =  0.200000003  for
stability 1  swmin     =  0.119999997  for
stability 2  swmin    =  7.99999982E-02  for
stability 3  swmin    =  5.99999987E-02  for
stability 4  swmin    =  2.99999993E-02  for
stability 5  swmin    =  1.60000008E-02  for
stability 6
   symin   = 1.00000000  szmin   = 1.00000000
szcap_m  =  5000000.00  xminzi   =  50.0000000
xmaxzi  = 3000.00000   plx0    = 7.00000003E-
02    for stability 1  plx0     =  7.00000003E-
02    for stability 2  plx0     =  0.100000001
for stability 3  plx0     =  0.150000006    for
stability 4  plx0      =  0.349999994     for
stability 5  plx0      =  0.550000012     for
stability 6
   ptg0     =  1.99999996E-02    for stability
5  ptg0     =  3.50000001E-02    for stability
6
   ppc      =  0.500000000    for stability 1
ppc       =  0.500000000     for stability 2
ppc       =  0.500000000     for stability 3
ppc       =  0.500000000     for stability 4
ppc       =  0.349999994     for stability 5
ppc       =  0.349999994     for stability 6
tbd     =  0.500000000  tibldist =  1.00000000
10.0000000 9.00000000  nlutibl  =  4  fclip
=  0.00000000E+00  nsplit   =  3  iresplit =
0 0 0 0          =  0 0 0 0
          =  0 0 0 0
          =  0 0 0 0
          =     0  1  0  0
=   0  0  0  0   zisplit   =
100.000000     roldmax    =
0.250000000  nsplith  =  5
sysplith  =     1.00000000
shsplith  =     2.00000000
cnsplith =  1.00000001E-07
epsslug  =   9.99999975E-05
epsarea  =   9.99999997E-07
dsrise      =    1.00000000
trajincl  =     20.0000000
mdepbc    =   1  htminbc   =
500.000000   rsampbc      =
10.0000000


-------------  INPUT GROUP 13  ---------------


npt1    = 0 iptu    =  5   units
=   OUV/s
       converted to g/s, odour_units*m3/s, or Bq/s
by factor:  1.00000000  nspt1    =  0  npt2     =
0


 -------------  INPUT GROUP 14  ---------------
   nar1     =  1  iaru     =  5   units =
OUV/s/m^2      converted to g/s/m^2,
odour_units*m/s,     or Bq/s/m^2  by
factor:  1.00000000  nsar1    =  1  nar2
=  0
   cnamar1         =    EP1
htar1    =  0.00000000E+00
elar1       =    83.6999969
sz0ar1   =  1.00000000
   area source: EP1                number:
1  qar1       =   2877.41382   area1     =
2877.41382
 [x,y]ar1grd  =  77.6664200 60.3580704
 [x,y]ar1grd  =  78.1730118 60.3255196
 [x,y]ar1grd  =  78.1665039 60.0781212
 [x,y]ar1grd  =  77.6664200 60.0976524
 ODOR        Emission Factor Type: WSP6_PGCLASS6
 Index  1  to  6  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
 Index  7  to  12  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
 Index  13  to  18  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
 Index  19  to  24  Emission Factor =  2.29999995 2.29999995 2.29999995 2.29999995 2.29999995 2.29999995
 Index  25  to  30  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
Index  31  to  36  Emission Factor =  1.89999998 1.89999998 1.89999998 1.89999998 1.89999998 1.89999998
 -------------  INPUT GROUP 15  ---------------
   nln2     =  0  nlines   =  0  ilnu     =  5
units =   OUV/s             converted to g/s,
odour_units*m3/s, or Bq/s        by factor:
1.00000000  nsln1    =  0  xl       =
0.00000000E+00  hbl      =  0.00000000E+00  wbl
=  0.00000000E+00  wml      =  0.00000000E+00  dxl
=  0.00000000E+00  fprimel  =  0.00000000E+00
mxnseg     =  7  nlrise   =  6
```

```
 -------------  INPUT GROUP 16  --------------
   nvl1     =  0  ivlu     =  5   units =   OUV/s
converted to g/s, odour_units*m3/s, or Bq/s
by factor:  1.00000000  nsvl1    =  0  nvl2     =
0



 -------------  INPUT GROUP 17  --------------
   nfl2      =
0


 -------------  INPUT GROUP 18  --------------
   nrd1      =
0  nrd2      =
0  nsfrds    =
0



 -------------  INPUT GROUP 20  --------------
   nrec     =  2  nrgrp    =  1  xng          yng
zng          elevng        group  62.2399864 58.4635391
0.00000000E+00 70.9000015 DISCRETE
 72.2932892 72.2200470 0.00000000E+00 100.800003 DISCRETE



 ---------------------------------------------------------------------------------------------------------------------------------
         INPUT FILES


 Default Name     Unit No.     File Name and Path
 ------------     --------     ------------------
  CALPUFF.INP        1        EP1_calpuff.inp
 (CALMET Domain: 1 )  MASTER
   CALMET.DAT       100        ..\..\CALMET\201701_CALMET.DAT
     (----)         100        ..\..\CALMET\201702_CALMET.DAT
     (----)         100        ..\..\CALMET\201703_CALMET.DAT
     (----)         100        ..\..\CALMET\201704_CALMET.DAT
     (----)         100        ..\..\CALMET\201705_CALMET.DAT
     (----)         100        ..\..\CALMET\201706_CALMET.DAT
     (----)         100        ..\..\CALMET\201707_CALMET.DAT
     (----)         100        ..\..\CALMET\201708_CALMET.DAT
     (----)         100        ..\..\CALMET\201709_CALMET.DAT
     (----)         100        ..\..\CALMET\201710_CALMET.DAT
     (----)         100        ..\..\CALMET\201711_CALMET.DAT
     (----)        100      ..\..\CALMET\201712_CALMET.DAT                                                                            -
---------------------------------------------------------------------------------------------------------------------------------
         OUTPUT FILES


 Default Name     Unit No.     File Name and Path
 ------------     --------     ------------------
  CALPUFF.LST       2      EP1_CALPUFF.LST                                                                                   CONC.DAT
8        EP1_CALPUFF.CON



 SETNEST: Setup results for nested CALMET grids
 ----------------------------------------------


 Properties of each CALMET domain grid


   Domain      =  1
   Origin(m)   =  704879.000 8547480.00  nx,ny,cell(m)
=  120 120 150.000000
   Nest Factor =  1
 Offset nx0,ny0=  0.00000000E+00 0.00000000E+00
 Corner coordinates in outermost grid units:
   LL Corner   =  0.00000000E+00 0.00000000E+00
   UR Corner   =  120.000000 120.000000  Horizontal
splitting parameters for domain:
   SYSPLITH(m) =  150.000000
 SHSPLITH(m/s) =  8.33333358E-02




  LAST PERIOD PROCESSED ENDS AT:
      Year: 2018  Month:  1   Day:  1   Julian day:   1   Hour:  0   Second:    0




  End of run -- Clock time: 20:18:10
                    Date: 05-27-2019


        Elapsed Clock Time:    11222.0 (seconds)
                  CPU Time:    10900.7 (seconds)
```

**Appendix B –**

Source, OER and BPIP configurations

| Source Name (12 chars.) | X Coord. (km) | Y Coord. (km) | Stack Height (m) | Base Elev. (m) | Stack Diam. (m) | Exit Veloc. (m/s) | Exit Temp. (K) | Building Downwash (0., 1., or 2.) | Platform Height (m) | Vertical Momentum Flux Factor (0. or 1.) | ODOR (ou/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stack** | 716.762 | 8556.455 | 10 | 85.5 | 0.5 | 10 | 363.15 | 1 | 0 | 1 | 98175 |

| Source Name (12 chars.) | Lower Left X Coord. (km) | Lower Left Y Coord. (km) | Upper Left X Coord. (km) | Upper Left Y Coord. (km) | Upper Right X Coord. (km) | Upper Right Y Coord. (km) | Lower Right X Coord. (km) | Lower Right Y Coord. (km) | Effect. Height (m) | Base Elev. (m) | Init. Sigma Z (m) | ODOR (ou/m**2/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EP1** | 716.529 | 8556.534 | 716.605 | 8556.529 | 716.604 | 8556.492 | 716.529 | 8556.495 | 0 | 83.7 | 1 | 11.1 |
| **EP2** | 716.529 | 8556.489 | 716.565 | 8556.488 | 716.564 | 8556.454 | 716.528 | 8556.454 | 0 | 83.7 | 1 | 2.78 |
| **EP3** | 716.569 | 8556.488 | 716.605 | 8556.487 | 716.604 | 8556.453 | 716.569 | 8556.454 | 0 | 83.7 | 1 | 2.78 |

Batchelor

```
                              BPIP (Dated: 04274)
 DATE :  5/23/2019
 TIME : 15:32:43
 Batchelor

 ============================
BPIP PROCESSING INFORMATION:
 ============================


   The P  flag has been set for preparing downwash related data
for a model run utilizing the PRIME algorithm.


   Inputs entered in METERS     will be converted to meters using
a conversion factor of    1.0000.  Output will be in meters.


   The UTMP variable is set to UTMY.  The input is assumed to be in
     UTM coordinates.  BPIP will move the UTM origin to the first pair of
     UTM coordinates read.  The UTM coordinates of the new origin will
be subtracted from all the other UTM coordinates entered to form       this
new local coordinate system.


   The new local coordinates will be displayed in parentheses just below
the UTM coordinates they represent.


   Plant north is set to   0.00 degrees with respect to True North.






 ==============
INPUT SUMMARY:
 ==============



 Number of buildings to be processed :   1



 RPlant   has 1 tier(s) with a base elevation of   85.50 METERS
 BUILDING  TIER  BLDG-TIER  TIER   NO. OF      CORNER   COORDINATES
   NAME   NUMBER   NUMBER  HEIGHT  CORNERS        X           Y


 RPlant      1        1      6.00     4
                                              716762.00  8556463.00 meters
                                          (        0.00        0.00) meters
                                              716783.00  8556463.00 meters
                                          (       21.00        0.00) meters
                                              716782.00  8556444.00 meters
                                          (       20.00      -19.00) meters
                                              716761.00  8556444.00 meters
                                          (       -1.00      -19.00) meters


 Number of stacks to be processed :   1


                  STACK            STACK   COORDINATES
  STACK NAME     BASE  HEIGHT          X           Y


  Stack         85.50   10.00 METERS
                                   716762.00  8556455.00 meters
(        0.00       -8.00) meters



 The following lists the stacks that have been identified
as being atop the noted building-tiers.
```

```
          STACK            BUILDING         TIER
NAME      NO.    NAME        NO.  NO.
          Stack      1     RPlant       1     1



                     Overall GEP Summary Table
                          (Units: meters)



 StkNo:  1  Stk Name:Stack    Stk Ht:  10.00 Prelim. GEP Stk.Ht:   65.00
            GEP:  BH:   6.00  PBW:   19.00             *Eqn1 Ht:   15.00
          *adjusted for a Stack-Building elevation difference of    0.00
  No. of Tiers affecting Stk:  1  Direction occurred:   90.00    Bldg-
Tier nos. contributing to GEP:   1
```